Journal of Applied Intelligent System (e-ISSN : 2502-9401 | p-ISSN : 2503-0493)
Vol. X No. X, February 2017, pp. 1 – 5
DOI:

Optimization Water Conservation Through IoT Sensor Implementation At Smartneasy Nusantara

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Received 8 December 2015; Revised 10 February 2016; Accepted 2 March 2016

Abstract – The use of IoT sensors in technology is a fascinating research subject due to the possibility of real-time monitoring of water usage and temperature effects. Developing tools and systems that make observations of water usage through Max6675 sensors can optimize data collection and processing through remote monitoring. Utilizing the IoT technique, the ESP8266 WeMOS D1 R2 microcontroller and the Max6675 temperature sensor are utilized to regulate the water pump via a relay. This approach enhances water sustainability for plant assumptions based on the predetermined temperature. The device activates the water pump when the temperature surpasses the standard level at the observation site. The outcome indicated that this device operates accordingly with a 100% success rate. The device was determined to function effectively by activating the water pump based on temperature. Additionally, it can provide real-time monitoring data and process sensor data for analysis.

Keywords – IoT, Microcontroller, ESP8266 WeMOS, Max6675, Real Time.

1. INTRODUCTION

Electricity and water are essential resources for humans, with electricity being used to power electronic devices that facilitate human work. However, the usage of these resources is often unregulated, necessitating the implementation of water conservation techniques using IoT technology to optimize their usage. Mismanagement of water in an ungoverned industrial setting would lead to wasteful usage and hinder growth [1]. PT Smartneasy Nusantara is a company that was established in 2010. Water conservation has not been fully optimized in this project, which serves as the foundation for research into developing an innovation that utilizes IoT sensors to facilitate water conservation.

The objective of the study is to create water conservation systems and sensors, which would facilitate the development of future systems. This would enable systems to optimize water conservation by using IoT sensors and to acquire systems integrated with IoT sensors in water usage. This would allow for the optimization of plant products while saving on manual and automatic processes, all aimed at achieving water conservation.

2. RESEARCH METHOD

2.1. Device Structure IoT

Below is the IoT platform structure to turn on the water pump based on temperature:

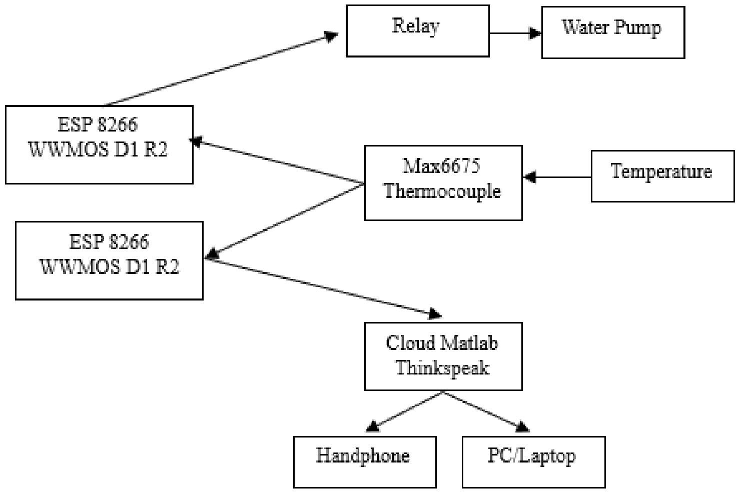

Figure 1. Device structure IoT.

Based on the framework developed at Max667, the thermocouple would obtain the temperature data from the plant's location. This data would then be sent to the microcontroller ESP8266 WeMOS D1 R2 and engineered to operate as a system for turning the relays of the water flusher engine on and off based on the prescribed temperature score. Technical abbreviations such as ESP8266 WeMOS D1 R2 should be explained when first used.

2.2. Flowchart Device

In general, the workings of the device can be explained in the following pictures:

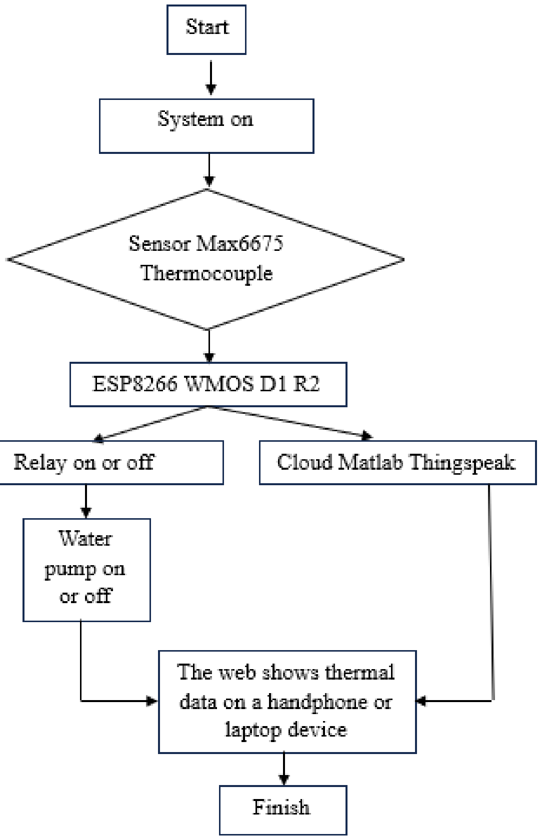

Figure 2. Flowchart device.

2.3. *Software and Hardware Design*

Hardware comprises all the physical components of a device that use heat sensors to activate water, which will then execute a previous command from software. Software is a compilation of commands that a computer executes while performing its tasks. This software contains a storage apparatus for commands, as well as other documents and archives [2].

2.3.1. *Microcontroller ESP8266 WeMOS D1 R2*

A microcontroller is a chip that functions as an electronic circuit controller and can generally store programs in it. Microcontrollers generally consist of a CPU, memory, certain I/O, and support units such as analog to digital converter (ADC) that are already integrated in it [3]. The microcontroller functions as both a relay interface and a data processor. Technical term abbreviations will be explained upon first usage. Micro controlling principles dictate the use of input/output facilities designed to receive input signals (input) and provide output signals (output). These signals are represented as 1 (high, equivalent to 5 volts) and 0 (low, equivalent to 0 volts) in a digital format [4].

2.3.2. *Max6675 Thermocouple*

A thermocouple is a type of temperature sensor that is used to detect or measure temperature through two different types of metal conductors that are joined at the ends to create a “Thermoelectric” effect [5}. The Max6675 was created using an arduino driver that includes final cold compensation, linear corrections, and a 12-bit analog to digital converter with end-of-life thermocouple, providing serial resolution [6].

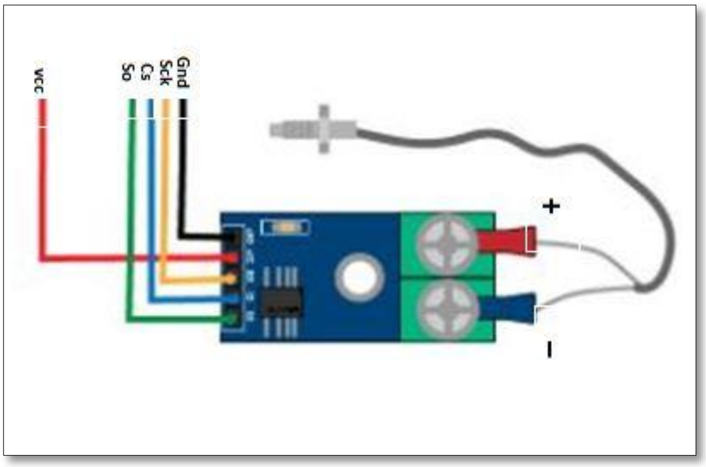

Figure 3. Skema sensor Max6675 Thermocouple.

Below is the Max6675 pin chart used for ESP826 and thermocouple as follows:

Table 1. Pin sensor Max6675 Thermocouple

Pin Max6675 for Esp8266	Pin Max6675 for Thermocouple
Pin SO	Pin + (Red wire)
Pin CS	Pin - (Blue wire)
Pin SCK	
Pin VCC	
Pin GND	

2.3.3. USB 3.0

The USB is an electronic device that converts 150 mA to 5 V. Its function includes operating as a power supply, as well as a battery or battery discharge [7]. The USB was selected due to its ability to generate a constant voltage for the board node-MCU to receive.

2.3.4. Design Software and Hardware

The designer of this software utilized ideas from arduino software, which affords the benefit of an inherent library while simultaneously adding support for other microcontrollers. The device comprises crucial hardware components including the ESP8266 WeMOS D1 R2 microcontroller, MAX6675 thermocouple, water pump, relay, cloud Matlab, and web Thingspeak [8].

The programming of microcontrollers involves the utilization of C language in three fundamental parts. The initial section pertains to variable storage, which serves as data storage locations for essential information such as wifi names, passwords, and fire tokens [1]. The second segment entails the void setup function, executed as the first function after the microcontroller is powered on in order to provide command initialization. The final component of the third part is the void loop, which executes after the completion of the void setup. Voloop functions are integral to the primary program and run sequentially from the start to the end, repeatedly.

2.4. Assembly of Hardware

This process of assembling the device with the raw materials described requires several stages, the stages as follows:

1. Assembly control module relay.
2. Assembly module cloud matlab thingspeak.
3. A series of top component details:
    a. Relay pin.
    b. Max6675 Thermocouple pin sequence.

2.5. Mockup of a View on Web Thingspeak

Thingspeak is a system that can schedule and run Matlab code using the version of Matlab that Math Works hots in the cloud [9]. This web-based Thingspeak display presents information on water usage, including minute-by-minute temperature graphs displaying temperature in degrees Celsius that are color-coded. Additionally, the status of the lights indicates the relay for life and death [10].

Figure 4. Mockup of a view on web thingspeak

2.6. Functional Testing

Testing functional units to determine whether the required components can function correctly in response to the given commands [11].

2.6.1. Testing Microcontrol ESP8266 WeMOS D1 R2

ESP8266 WeMOS D1 R2 is equipped with a push button, namely the reset and flush buttons. Although the ESP8266 WeMOS D1 R2 uses the Lua language, this language has the same logic and programming structure as the C language, only the syntax is different [12]. ESP8266 WeMOS D1 R2 is also supported with Arduino IDE software by setting the board manager on the Arduino IDE [13]. Testing all pins of the ESP8266 WeMOS D1 R2 allows for a comprehensive evaluation of their functionality. The following steps outline the process for testing the ESP8266 WeMOS D1 R2. By conducting this test, the functionality of each pin and port can be established. This enables a full understanding of the characteristics of this particular microcontroller [14]. Testing all pins of the ESP8266 WeMOS D1 R2 allows for a comprehensive evaluation of their functionality:

1. Multimeter release.
2. High or low port I/O voltage measurements used.

2.6.2. Max6675 Thermocouple Sensor Testing the Relay

The aim of the Max6675 Thermocouple sensor testing and associated experimentation was to ascertain the efficacy and functionality of the devices employed, as well as to gain a comprehensive understanding of the workings of these two components, encompassing both circuit and programming aspects [15].

2.6.3. System Test Work

The objective of testing the operational system is to determine whether the testing software can execute correctly with the established hardware circuit and the pre-existing web controls. This ensures that the system functions adequately and without errors.

3. RESULTS AND DISCUSSION

Testing on soil conditions made a research site within 7 days resulted in the temperature conditions for the soil as follows:

Table 2. Soil Testing Temperature Conditions

Day	Morning Soil (Celcius)	Early afternoon soil (Celcius)	Afternoon soil (Celcius)
Day-1	28°	32°	28°
Day-2	26°	30°	27°
Day-3	27°	31°	28°
Day-4	28°	32°	27°
Day-5	28°	32°	27°
Day-6	29°	32°	28°
Day-7	28°	31°	28°

According to the table provided, an average temperature of 29°C was recorded under conditions where the soil was mixed with water and under conditions where the soil was not mixed with water. The resultant average temperature of 7 days was 34°C and is used as a reference point to trigger sprinklers through temperature sensors. Accordingly, if soil temperature readings are below 34°C, the soil is moist, otherwise, it is dry.

After calculating the average temperature over a period of 7 days to serve as a temperature reference, the subsequent monitoring process utilizes web thingspeak. If the indicator on the green monitor detects that the ground temperature falls below 34°C, the relay disengages the current, preventing the sprinklers from being activated.

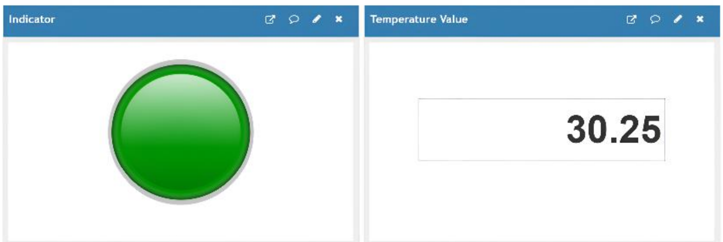

Figure 5. Green indicator

If the monitoring device displays red indicators, it indicates that the soil conditions exceed 34°C. Subsequently, the relays will activate and establish the required electrical connections for the sprinkling process.

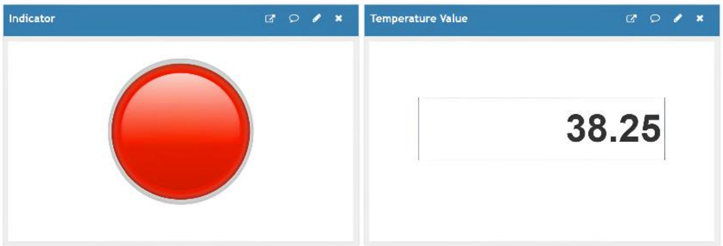

Figure 6. Red indicator

During flushing, it takes around 30 minutes to restore soil temperature by 34°C or below 34°C in soil conditions above 34°C. Technical abbreviations will be explained upon their first use. If the soil temperature reaches 34°C or below, the web-based monitoring display on Thingspeak turns green after the sprinkler pump's power is cut off. The text has a logical flow of information, a clear structure, and uses value-neutral language.

4. CONCLUSION

Based on the research conducted, it can be concluded that IoT modules can be designed from the early stages to optimize water conservation. The testing and implementation of the device have shown that it works as intended. Through temperature monitoring and sensor data processing, devices can optimize water usage consistently. Technical abbreviations such as IoT should be defined at first use.

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